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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/657,789	09/08/2003	Yuan-Hsun Wu	10112881	1374

34283 7590 02/15/2006

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EXAMINER	
RUGGLES, JOHN S	

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 02/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/657,789	WU, YUAN-HSUN	
	Examiner	Art Unit	
	John Ruggles	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 January 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) *7-12* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 September 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election **without** traverse of Group I, claims 1-6, in the reply filed on 1/9/06 is acknowledged. Claims 7-12 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention.

Drawings

Figures 5A and 6A should be designated by a legend such as --Prior Art-- because only that which is old is illustrated (as admitted by Applicant in the brief description of Figures 5A and 6A at page 4 lines 11-13 and 17-19, respectively). See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

The abstract of the disclosure is objected to because (1) at lines 7-10, "distance between the assist pattern and its upper and lower array patterns is equal, and the length of the assist pattern is equal to the width of the array pattern" should be changed to --distances between [[the]] each assist pattern and its upper and lower array patterns [[is]] are equal, and the length of [[the]] each assist pattern is equal to the widths of [[the]] its upper and lower array patterns-- and

(2) at lines 16-17, "critical dimension between array patterns" should be changed to --critical dimensions between array patterns--. Correction is required. See MPEP § 608.01(b).

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms, which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are: (1) at page 2 line 10, "the off-axis illumination" lacks antecedent basis and should be changed to --[[the]] an off-axis illumination--; (2) at page 3 lines 4-7, "distance between the assist pattern and its upper and lower array patterns is equal, and the length of the assist pattern is equal to the width of the array pattern" should be changed to --distances between the assist pattern and its upper and lower array patterns [[is]] are equal, and the length of [[the]] each assist pattern is equal to the widths of [[the]] its upper and lower array patterns--, similar changes should also be made throughout the specification (e.g., at page 5 lines 12-17, etc.); and (3) at page 4 line 24, "Figs. 2~6B" should be corrected to --Figs. [[2~6B]] 2-4B, 5B, and 6B--, in accordance with the instant invention as illustrated by these latter figures described at page 4 lines 3-22. Note that due to the number of errors, those listed here are merely *examples* of the corrections needed and do *not* represent an exhaustive list thereof.

Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 5 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The specification as originally filed does not support the thickness of the light-shielding layer to be about 150~200nm, as recited in claim 5.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-6 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1 lines 5-7, (1) it is unclear to which of the "plurality of assist patterns" the phrase "the assist pattern" (singular, both in line 5) is meant to refer and (2) it is also unclear to which of the "upper and lower array patterns" (plural, in line 6) the phrase "the array pattern" (singular, in line 7) is meant to refer. Both of the phrases "the assist pattern" in line 5 and "the array pattern" in line 7 also lack proper antecedent basis. However, for the purpose of this Office action and in order to advance the prosecution of this application, claim 1 lines 5-7 have been interpreted as follows: --area and a plurality of assist patterns, wherein the distances

between [[the]] each assist pattern and its upper and lower array patterns [[is]] are equal, and the length of [[the]] each assist pattern is equal to the widths of [[the]] its upper and lower array patterns--. Claims 2-6 depend on claim 1.

Claim Rejections - 35 USC § 102/103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 1 is rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Lin (US Patent 6,238,825).

Lin teaches a mask having a plurality of layout or array patterns alternating with scattering bars or assist patterns as additional rectangular openings (understood to be in the light-shielding layer disposed on a transparent substrate) placed next to the edges of adjacent layout or array patterns (title, abstract) to reduce or eliminate proximity effects during a lithography exposure process (col. 1 lines 15-20, which is also understood to reduce lens aberration and/or

pattern displacement). Figure 3A shows an exposed pattern of circular contact holes 300 made by such a mask having alternating narrow rectangular scattering bars or assist patterns 302 adjacent square layout or array patterns, both of which are clear areas having 100% transmission (col. 2 lines 52-61). Therefore, it is understood that both the layout or array patterns and the adjacent scattering bars or assist patterns are formed on the mask as openings in a light-shielding layer disposed on a transparent substrate. In order to form the uniformly shaped circular contact holes 300 centered at the square layout or array patterns as shown in Figure 3A, the distances between each scattering bar or assist pattern and its upper and lower adjacent layout or array patterns would inherently have to be equal, and the length of each such scattering bar or assist pattern is illustrated to be equal to the width of the upper and lower layout or array patterns (reading on instant claim 1).

Claims 1 and 4 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Misaka (US Patent Application Publication 2004/0121244).

Misaka teaches various photomask or mask patterns and methods of producing and using them (title, abstract). Figures 19(a)-19(d) show various examples of masks having rectangular main pattern openings or array patterns in a semi-light-shielding layer (which in Figure 19(d) is further surrounded by a complete-light-shielding portion) on both sides of an intermediate narrow transparent phase shifter or assist pattern (positioned based on a centerline enhancement method, which is understood to mean that the assist pattern is positioned at the center of the distance between adjacent main or array pattern openings). The length of the assist pattern is

equal to the width of the adjacent main or array pattern openings (paragraphs [0191-0196]), reading on instant claim 1). A semi-light-shielding portion in this reference has a transmittance to exposure light of 15% or less and is described to be made of a metal, such as chromium (Cr) [0111], which is also very well known to be a complete-light-shielding layer when patterned in sufficient thickness on a transparent substrate, as shown in Figure 7(b) and described in [0153] (reading on instant claim 4). An ArF light source for an exposure wavelength of 193 nm is contemplated [0134, 0142].

Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liebmann et al. (US Patent Application Publication 2004/0172610).

Liebmann et al. teach a method of designing a mask having a pitch-based sub-resolution assist feature (SRAF) configured between adjacent main or array patterns to optimize the resulting image projected through the mask (title, abstract). Figure 3A illustrates two adjacent rectangular primary repeating features 301 or array patterns positioned at a desired design pitch (P_D) and an intermediate SRAF 710 placed midway between the primary array patterns 301 based on the design pitch P_D [0101]. Therefore, the distances between the assist pattern and its adjacent primary array patterns are equal. The length of the assist pattern is equal to the width of the adjacent primary array patterns, as shown in Figure 3A.

Liebmann et al. do not teach that this mask pattern is made by patterning openings in a light-shielding layer on a transparent substrate.

However, it would have been obvious to one of ordinary skill in the art at the time of the invention to have made a patterned mask having a pitch-based sub-resolution assist feature

(SRAF) taught by Liebmann et al. that included patterned openings in a light-shielding layer on a transparent substrate, because this combination is notoriously well known in the art of making patterned masks and would allow the formation of a resulting image to be projected through the mask, which was clearly contemplated by Liebmann et al.

Claims 2-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (US Patent 6,238,825), Misaka (US Patent Application Publication 2004/0121244), or Liebmann et al. (US Patent Application Publication 2004/0172610) in view of Inoue et al. (US Patent 5,422,205).

The teachings of Lin, Misaka, and Liebmann et al., as discussed above, do not fully specify that the mask transparent substrate is either quartz (instant claim 2) or calcium fluoride (CaF_2, instant claim 3), nor that the light-shielding layer is chromium (Cr, instant claim 4) for the patterned masks described by these references.

However, these materials for the transparent substrate and the light-shielding layer of patterned masks have been well known for some time, as exemplified by Inoue et al. Figure 13A shows a mask having a patterned light shielding film 512 (of e.g., chromium (Cr), etc.) with auxiliary or assist pattern openings 515 adjacent to a main or array pattern opening 514 on a substrate 511 (of e.g., quartz, calcium fluoride (CaF_2), etc.) that is transparent to exposure light (col. 15 lines 4-12). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have made any of the patterned masks taught by Lin, Misaka, or Liebmann et al. with a transparent substrate of either quartz (instant claim 2) or calcium fluoride (CaF_2, instant claim 3) and/or a light shielding layer pattern of chromium (Cr, instant claim 4),

because these materials have been well known for some time, as exemplified by Inoue et al., and these materials have also been in common use in patterned masks for radiation lithography since the time of Inoue et al.

Claims 2-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (US Patent 6,238,825), Misaka (US Patent Application Publication 2004/0121244), or Liebmann et al. (US Patent Application Publication 2004/0172610) in view of Miyashita et al. (US Patent 5,380,608).

The teachings of Lin, Misaka, and Liebmann et al., as discussed above, do not fully specify that the mask transparent substrate is either quartz (instant claim 2) or calcium fluoride (CaF_2, instant claim 3), nor that the light-shielding layer is chromium (Cr, instant claim 4) for the patterned masks described by these references. Also, none of these references specifically teach that the thickness of the light-shielding layer (of Cr) is about 150-200 nm (instant claim 5).

Miyashita et al. teach various photomasks or masks having patterned opaque or light-shielding layers. In Figure 1a, the thickness of a light-shielding layer 32 (of e.g., Cr, etc., instant claim 4) is 10-200 nm on a transparent substrate (of e.g., quartz, CaF_2, etc., col. 6 lines 17-49, instant claims 2-3). The light-shielding layer 32 is subsequently patterned by etching to form an opaque or light-shielding pattern 37, as shown by Figure 1m (col. 6 line 66 to col. 7 line 2). Another mask has an opaque or light-shielding layer 53 thickness of 50-200 nm (entirely encompassing the instant claim 5 range of 150-200 nm), as shown by Figure 2a (col. 8 lines 24-30), which is then etched to form an opaque or light-shielding pattern 58, as shown by Figure 2d

(col. 8 lines 5-8). Cr is the preferred material for an opaque or light-shielding layer 72 having a thickness of 10-200 nm, as shown in Figure 3a (col. 10 lines 5, 20-21, and 48-51).

However, it would have been obvious to one of ordinary skill in the art at the time of the invention to have made any of the patterned masks taught by Lin, Misaka, or Liebmann et al. with a transparent substrate of either quartz (instant claim 2) or calcium fluoride (CaF_2, instant claim 3) and/or a light shielding layer pattern of chromium (Cr, instant claim 4) having a thickness in the range of 10-200 nm (entirely encompassing the instant claim 5 thickness of about 150-200 nm). This is because these materials as well as a thickness in this range of light-shielding material have been well known for some time, as exemplified by Miyashita et al., and these materials have also been in common use in patterned masks for radiation lithography since the time of Miyashita et al.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lin (US Patent 6,238,825), Misaka (US Patent Application Publication 2004/0121244), or Liebmann et al. (US Patent Application Publication 2004/0172610) in view of Chen et al. (US Patent 6,312,854).

While teaching other aspects of the instant invention, Lin, Misaka, or Liebmann et al., as discussed above, do not specify that the width of the mask assist pattern is about 60-80 nm (instant claim 6).

Chen et al. teach methods of making patterned masks having sub-resolution anti-scattering bars (e.g., assist patterns, etc.) for optically transferring lithographic patterns onto a semiconductor substrate (title, abstract). Claim 32 describes the width of a scattering bar or assist pattern to be equal to K_w (λ/NA_O), in which K_w is 0.2-0.25, λ is the exposure wavelength,

and NA_O is the numerical aperture of the objective lens for the exposure. Figure 5B shows KrF exposure (λ = 248 nm) and NA = 0.57 (col. 7 line 19), which comes out to an assist pattern width of 87-109 nm. However, ArF exposure (λ = 193 nm) is acknowledged to be another alternative known DUV wavelength (col. 1 lines 19-22). For λ = 193 nm, the scattering bar or assist pattern width would be 68-85 nm, and with NA = 0.61 (as shown by Figure 6), the scattering bar or assist pattern width would be further reduced to 63-79 nm (reading on the instant claim 6 assist pattern width of about 60-80 nm).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have made any of the patterned masks taught by Lin, Misaka, or Liebmann et al. with an assist pattern having a width of 63-79 nm (as taught by Chen et al.), in order to ensure that the assist pattern would perform properly as a sub-resolution (anti-) scattering bar or assist pattern that would improve resolution in the manner shown by Lin, Misaka, or Liebmann et al. without printing on the exposed resist (reading on the instant claim 6 assist pattern width of about 60-80 nm).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

John Ruggles
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